Learning Graphical Models Using Multiplicative Weights

Chongyang Bai, Chao Chen, Rui Liu

Motivation

We choose this paper because we are interested in neural networks, deep learning, and their applications. Boltzmann machines are the one of the first neural networks capable of learning internal representations. Neural network models use on Boltzmann machines to do classification task [1, 2]. This paper focuses on MWU's application for graphical models, especially, Markov random fields and Boltzmann machines. The approach is claimed to have a nearly optimal number of sample complexity and running time of $\hat{O}(n^2)$, which is a huge improvement to the prior works.

Generalized Linear Models (GLM) unifies a set of fundamental classifiers and regressors, including linear regression, logistic regression, and Poisson regression. Another interesting point of the paper is that the authors offer the first solution to the problem of learning sparse Generalized Linear Models while holding the online setting.

Agenda

The goal of the project is to digest the paper completely and apply it to some practical problems.

- We will begin to study this algorithm with learning Ising model.
- Then, we will move on to the general case of learning $t - wise$ MRFs.
- After digesting the paper, we will implement the proposed *Sparsitron* algorithm.
- Finally, we will evaluate the algorithm on a practical problem and compare its performance with other classifiers.

We will keep the following questions in mind:

- Why the *Sparsitron* algorithm has less sample complexity compared with *GLMtron* and *Isotron*
- Is this algorithm connected to stochastic gradient descent and belief propagation?
- Is it possible to apply MWU on graphic convolutional networks (GCN) and have lower sample complexity?

References

[1] Ruslan Salakhutdinov, Andriy Mnih, and Geoffrey Hinton. Restricted boltzmann machines for collaborative filtering. In *Proceedings of the International Conference on Machine Learning (ICML)*, pages 791–798. ACM, 2007. doi: 10.1145/1273496.1273596.

[2] Matthew Zeiler, Graham Taylor, Leonid Sigal, Iain Matthews, and Rob Fergus. Facial expression transfer with input-output temporal restricted boltzmann machines. In *Advances in Neural Information Processing Systems*, pages 1629–1637, 2011. URL https://papers.nips.cc/paper/4368-facial-expression-transfer-with-input-output-temporal-restricted-boltzmann-machines.pdf.